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Short Note

Response of genotypes under varying fertility levels and bio-fertilizer inoculations on growth and yield of Indian mustard (*Brassica juncea* L.)

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Abstract

A study was conducted in the *rabi* season of 2020-21 to assess the response of genotypes under varying fertility levels and bio-fertilizer inoculations on growth and yield of Indian mustard under humid and sub humid conditions. The sixteen treatment combinations of four genotypes of Indian mustard (Bio 902, DRMRIJ 31, RH 749 and NRCHB 101) and four fertility levels *i.e.* 75 % RDF (45 kg N + 30 kg P_2O_5/ha) 100 % RDF (60 kg N + 40 kg P_2O_5/ha), 75 % RDF + biofertilizer (liquid PSB and Azotobactor) and 100 % RDF + biofertilizer were taken in a factorial randomized complete block design with three replications. Among the various genotypes, 'DRMRIJ 31' recorded the maximum growth characteristics *viz*, plant height (49 186 and 207 cm), dry matter accumulation (17, 30 and 75 g/plant) at 30, 60 and at harvest and leaf area index (4.1) at 60 DAS, respectively. Among the fertility levels, 100% RDF + bio fertilizers recorded the maximum values of plant height, dry matter accumulation and leaf area index. The maximum seed yield (1812 kg/ha), stover yield (5123 kg/ha) and biological yield (6935 kg/ha) were recorded with DRMRIJ 31. Among fertility levels, the maximum seed yield (1694 kg/ha), stover yield (5065 kg/ha) and biological yield (6759 kg/ha) obtained under 100 % RDF + bio-fertilizer.

Keywords: *Bio-fertilizer, fertilizer level, growth, Indian mustard, yield*

Introduction

Indian mustard (*Brassica juncea* L.) is one of the most important oilseeds crop and it is playing a vital role in Indian economy (Prasad, 2015). It contributes 29 % in the total oilseeds production among the seven edible oilseeds cultivated in India (Choudhary *et al.,* 2021). Rapeseed-mustard production is estimated at 109.5 lakh tonnes during 2021-22. The area under coverage has been pegged at 87.44 lakh ha, while the average yield is seen at 1270 kg/ha. Oilseed crop plays an important role in agriculture economy of India. Our country is the largest oil economy in the world after the USA, China and Brazil in term of vegetable oil (Yadav *et al.,* 2018). Rajasthan, Uttar Pradesh and Haryana are the major mustard growing states in the country. Rajasthan ranks first in area and production with 2.72 million ha area, production is expected to increase to 49.50 lakh tonnes in 2021-22 as per the Central Organization for Oil Industry Trade, New Delhi. In Rajasthan, Bharatpur and Eastern districts are contributing about 48 % of the total production of the state. Mustard oil is good for human consumption and good for health because of rich source of the unsaturated fatty acids (Brar *et al*., 2016) and relative proportions of glucosinolates *viz*., sinigrin, gluconapin and progoitrin are influenced by sulphur application (Hassan *et al*., 2007). Oil content of its seeds ranges from 38- 46 % and possess adequate amount of erucic acid (40-60%) with linolenic up to 4.5 to 13 %. The oleic acid and linoleic acid which have a higher nutritive value together constituent only about 25-30 %.

Nutrient elements particularly nitrogen (N) which is deficient in most of our Indian soils and plays appreciably an important role in *Brassica* crops (Singh and Meena, 2004). It is an integral component of amino acid, nucleic acids, proteins, nucleotides, chlorophyll, chromosomes, genes, ribosomes and also a constituent of all enzymes. Phosphorus is a constituent of several essential cell components like nucleotides, nucleic acids and phospholipids which promotes root development of the crop. Bio fertilizer play an important role in the improvement of soil biological, physical and chemical properties and its play important role in increasing soil fertility, productivity of crop and their production in agriculture as they are eco-friendly (Solanki *et al*., 2018). Phosphate solubilizing bacteria inoculants when applied to crop plants, promote seed germination and initial vigor of plants by producing growth-promoting substances. Application of bio-fertilizers results in increased mineral and water uptake, root development, vegetative growth and nitrogen-fixation (Solanki *et al*., 2018). *Azotobacter* inoculants when applied to many non-leguminous crop plants, promote seed germination and initial vigor of plants by producing growth promoting substance (Yadav *et al*., 2010).

Materials and Methods

The experiment was conducted at Instructional Farm of Agronomy, Rajasthan College of Agriculture, Udaipur under humid and sub humid conditions. The site is situated at South-Eastern part of Rajasthan at an altitude of 581.13 m above MSL (Mean Sea Level), 24°35' N latitude and 73°42' E longitude. The region falls under NARP agro-climatic zone IV a (sub- humid southern plain and Aravalli hills) of Rajasthan which consist of districts of Udaipur, Rajsamand, Chittorgarh, Bhilwara and Sirohi. This zone comes in typical sub-tropical climatic conditions characterized by mild winters and average summers along with high relative humidity during the *rabi*. Weather conditions were favorable for the growth and development of the crop. The maximum and minimum temperatures during the crop growth period ranged between 22.5°C to 33.3°C and 3.8°C to 21.5°C, respectively. During the crop growth period and rainfall 10.6 and 12.6 mm was recorded. The maximum and minimum relative humidity during the crop growth period ranged between 63.7 to 90.6 % and 21.4 to 57.2 % respectively. The maximum and minimum sunshine duration during the crop growth period was 9.2 and 3.4 hrs, respectively. Total evaporation from open pan evaporimeter the maximum and minimum evaporation during the crop growth period was 5.9 and 2.6 mm. The average rainfall of the region is 627.8 mm, most of which is mainly contributed by south west monsoon from June to September. The soil was a clay loam in texture and slightly alkaline in reaction (pH 7.9), calcareous in nature and medium organic carbon (0.69 %). The available N, P_2O_5 and K_2O status of the experimental field was 282.3, 21.5, 294.7 kg/ha, respectively.

The experiment was laid out in a factorial randomized complete block design with sixteen treatment combinations which were replicated thrice. Each plot sized 4.0 m × 3.0 m. The treatment combinations were comprised of four genotypes (Bio 902, DRMRIJ 31, RH 749 and NRCHB 101) and four recommended dose of fertilizer (RDF) which content 75 % RDF (45 kg N + 30 kg P_2O_5/ha) 100 % RDF (60 kg N + 40 kg P_2O_5/ha) 75 % RDF + bio fertilizer (liquid PSB and Azotobactor) and 100 % RDF + bio fertilizer. The RDF was applied as per the treatments through Urea and DAP. Half dose of nitrogen and full dose phosphorus with bio-fertilizer was applied at the time of sowing and remaining half dose of nitrogen was applied at first irrigation. Mustard crop was raised with the seed rate of 5.0 kg/ha with the spacing of 30 cm × 10 cm. The crop was irrigated at 30, 60 and 85 DAS. Weeding was done at 15- 20 DAS by removing the weeds surrounding the plant. After third irrigation mustard crop began to be harvested at 120 DAS with the harvest criteria being that pod have a yellow color and the mustard pod has attained yellow color and were dried. The crop was harvested until 20% moisture has been left. After harvesting crop was sun dried for remove complete moisture. The data obtained were statistically analyzed by applying the techniques of analysis of variance and the significance of variance was tested at the probability level of 0.05.

Results and Discussion

Growth parameters

Among the mustard genotypes, the maximum values of growth parameters *i.e.* plant height and dry matter accumulation were observed with 'DRMRIJ 31' at 30, 60 DAS and at harvest stage. The maximum plant height (49, 186 and 207 cm), dry matter accumulation (17, 30 and 75 g/plant) at 30, 60 DAS and at harvest over Bio 902, NRCHB 749, NRCHB 101 and leaf area index (4.1) was observed under genotype 'DRMRIJ 31' at 60 DAS which were statistically at par with NRCHB 101 (Table 1). But plant height and dry matter accumulation statistically at par with NRCHB 101 (184 cm) at 60 DAS and at harvest (72 g/plant), respectively. The increasing in growth this might be due to their own inherent genetic makeup and similar findings were reported by (Kurmi, 2002; Singh, 2002). Its probable reason might be attributed to genetic characters of DRMRIJ 31 which has higher capacity to utilize the photosynthates more efficiently for maximum leaf area index, number of branches/plant and ultimately the dry matter production. Similar findings have been reported by (Chaplot *et al*., 2012). Among fertility levels, the highest plant height, dry matter accumulation and leaf area index were recorded under 100 % RDF+ bio fertilizer. The plant height at 30, 60 DAS and at harvest (51, 192 and 215 cm) was recorded significantly higher under 100 % RDF + bio fertilizer than the other treatments (Table 1). The highest leaf area index (4.4) recorded under 100 % RDF+ bio-fertilizer at 60 DAS. Further data indicated that the maximum dry matter accumulation was found under 100 % RDF + bio fertilizer by means of 7.51 and 5.24 %, respectively. Taller plants produced more dry matter because of more opportunity to production and

Table 1: Crop growth parameters of mustard as influenced by different genotypes and fertility levels

Treatments	Plant height (cm)			Dry matter accumulation (g/plant)			LAI at
	30DAS	60DAS	At harvest	30DAS	60DAS	Atharvest	60 DAS
Genotypes							
Bio902	43	169	203	12.4	27.3	69.5	3.8
DRMRIJ 31	50	187	208	17.2	30.1	75.1	4.1
RH 0749	47	175	190	15.5	23.8	68.7	3.5
NRCHB 101	43	184	196	16.2	27.4	72.2	4.1
SEm±	0.8	2.8	3.6	0.2	0.4	1.1	0.0
CD (*P*=0.05)	2.2	8.2	10.5	0.7	1.3	3.3	0.1
Fertility levels							
75% RDF	42	169	181	12.5	23.9	69.0	3.4
100% RDF	45	178	200	15.4	26.9	71.8	3.8
75 % RDF + bio-fertilizer	45	177	201	15.2	26.8	70.5	3.8
100% RDF + bio-fertilizer	51	192	215	18.3	31.1	74.2	4.4
SEm±	0.7	2.8	3.6	0.2	0.4	1.1	0.0
CD (*P*=0.05)	2.2	8.2	10.5	0.7	1.3	3.3	0.1

accumulation of photosynthates. Similar results were also observed by Mandal and Sinha (2002).

Yield performance

Genotype 'DRMRIJ 31' recorded the maximum seed yield (1812 kg/ha) followed by NRCHB 101 (1557 kg/ha) and Bio 902 (1380 kg/ha) (Table 2). The minimum seed yield was recorded with genotype 'RH 0749' (1221 kg/ha). Genotype 'DRMRIJ 31' enhanced seed yield by means of 31.30, 48.31, and 16.36 %, respectively. The stover and biological yield recorded significantly higher under genotype 'DRMRIJ 31' over Bio 902 (1380 kg/ha), RH 749 (1221 kg/ha) and NRCHB 101 (1557 kg/ha). Yield variations amongst mustard genotypes might be due to different genetic makeup. Higher seed and stover yield of 'DRMRIJ 31' genotype due to the aggressive growth attributes, better source and sink relationship which ultimately results in high yield and differences in various genotypes in their genetic makeup reported by Solanki *et al.* (2015). Similar findings were reported by Kumar *et al*., (2000). Among the fertility levels, the maximum seed, stover and biological yields were observed under 100% RDF + bio fertilizer. The seed yield produced with 100 % RDF + bio fertilizer was 1694 kg/ha followed by 75% RDF (1258 kg/ha), 100% RDF (1517 kg/ha) and 75 % RDF + bio fertilizer (1501 kg/ha). The maximum stover (5065 kg/ha) and biological yield (6759 kg/ha) were also recorded under 100% RDF+ bio fertilizer. The increase in seed and biological yield might be due to increase in branches under higher level of nitrogen and phosphorus application

Table 2. Yields performance of mustard as influenced under different genotypes and fertility levels

Treatment	Seed yield (kg/ha)	Stover yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
Genotypes				
Bio-902	1380	3889	5269	26.7
DRMRIJ 31	1812	5123	6935	26.2
RH 0749	1221	3414	4636	26.5
NRCHB 101	1557	4386	5943	26.3
SEm±	39.7	116.2	133.0	0.7
CD (*P*=0.05)	114.8	335.6	384.1	NS
Fertility levels				
75% RDF	1258	3204	4462	28.6
100% RDF	1517	4276	5793	26.2
75% RDF + bio fertilizer	1501	4269	5770	26.0
100% RDF + bio fertilizer	1694	5065	6759	25.0
SEm±	39.7	116.2	133.0	0.7
CD (*P*=0.05)	114.8	335.6	384.1	2.2

(Verma and Dawson 2019). Further, with the application of liquid PSB and Azotobactor biofertilizers further increase the yield, might be due to tissue differentiation from somatic to reproductive, meristematic activity and development of floral primordial. Higher fertility levels induced greater translocation of photosynthates from leaves to sink site accordance with the findings of (Bhari *et al.,* 2016).

Conclusion

The highest growth parameters as well as seed yield was obtained with the genotype 'DRMRIJ 31. Further, the maximum growth and seed yield was realized under the application of 100 % RDF + bio fertilizer. It can be concluded that seed treatment with bio-fertilizers in mustard was found beneficial in achieving the higher yield and could save chemical fertilizers substantially. Thus, use of *Azotobacter* and PSB for seed treatment along with 100 % RDF could be adopted for sustaining mustard production in sub-humid southern plain and Aravalli hills agro-climatic conditions of Rajasthan.

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